

APPROVAL SHEET FOR SUSPENDED LOAD OPERATIONS

SLO-KSC-1991-034

TITLE Operate, Inspect, Adjust, and Repair the Orbiter Payload Bay Doors at the Orbiter Processing Facility (OPF)

DOCUMENT NUMBER/TITLE OMI V9023.001, Orbiter Payload Bay Door Operations-Horizontal

PREPARED BY Malcolm Glenn

DATE 2/24/99

REQUIRED APPROVAL

CONTRACTOR	<input type="checkbox"/> DESIGN	<input type="checkbox"/> R & QA	<input type="checkbox"/> OPERATIONS	<input type="checkbox"/> SAFETY
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**NASA SUSPENDED LOAD OPERATION
ANALYSIS/APPROVAL (SLOAA)**

**SLO-KSC-1991-034
CHANGE 1, FEBRUARY 1999
PAGE 1 OF 4**

OPERATION: Operate, Inspect, Adjust, and Repair the Orbiter Payload Bay Doors at the Orbiter Processing Facility (OPF)

SUPPORTING DOCUMENTS: The associated operational procedure/systems assurance analyses are as follows:

1. OMI V9023.001, Orbiter Payload Bay Door Operations-Horizontal.
2. SAA09FTP3-006, System Assurance Analysis of the Horizontal Zero Gravity (G) Simulator for Orbiter Payload Bay Door and Radiators.

GENERAL DESCRIPTION: Contingency access operations will require no more than four personnel to be under the orbiter payload bay door while it is suspended from the Zero G system. Contingency operations include payload bay door/system inspections, repairs, and rigging adjustments/verifications. Examples of contingency operations include the following:

1. Observe inside of payload bay door as door is cycled to check for internal binding or excessive movement/shifting of door panels.
2. Insert/remove dowels between the payload bay door and the bulkhead roller to align the ready-to-latch switches.
3. Perform structural inspections of the payload bay door.
4. Install and rig payload bay door bulkhead latch rollers.

RATIONALE/ANALYSIS: The suspended load tasks comply with the NASA Alternate Safety Standard for Suspended Load Operations as follows:

Alternate Standard Requirement #1a: These operations cannot be conducted without placing personnel beneath the suspended payload bay door. The operations described have been evaluated and found to have no operational means to eliminate personnel from working under the suspended load.

The use of a secondary support system was investigated. Stands, capable of supporting the payload bay door in the event of a hoist failure would require a redesign of the orbiter payload bay support structure. In addition, installation and removal of the stands would potentially be a suspended load operation. The stands would also reduce access and hinder ingress/egress from the payload bay. Redesign of the orbiter payload bay support structure is not feasible.

Redesign of the orbiter payload bay doors and door support structure was also investigated. This was deemed not feasible because of the extensive flight

NASA SUSPENDED LOAD OPERATION
ANALYSIS/APPROVAL (SLOAA)

SLO-KSC-1991-034
CHANGE 1, FEBRUARY 1999
PAGE 2 OF 4

hardware redesign required and the associated reduced Space Shuttle payload capacity.

Alternate Standard Requirement #1b: The possible use of a secondary support system to catch the load in the event of a hoist failure was analyzed. It was determined the use of a secondary support system was not technically or operationally feasible due to access and orbiter load limitations.

Alternate Standard Requirement #1c: The maximum number of personnel permitted under the suspended load is four.

Alternate Standard Requirement #1d: The length of time required for personnel to work under the suspended load will vary depending on the operation performed. These operations will be planned and implemented to minimize the number of personnel and time required under the load. The length of time required for personnel to be under the load is estimated to range from 15 minutes to 2 hours.

Alternate Standard Requirement #2: Suspended load operations are reviewed and approved on a case-by-case/specific need basis - see General Description and Alternate Standard Requirement #1.

Alternate Standard Requirement #3: Only those suspended load operations approved by the Center NASA Safety Assurance Director will be permitted. A list of approved suspended load operations will be maintained by the Center NASA Safety Assurance Directorate.

Alternate Standard Requirement #4: OMI V9023.001 will be revised with deviation sheets or the work authorizing procedure performing the door inspection or adjustment/verification will be written to permit operations under the suspended load only when required. The OMI or work authorizing procedure will be available on site for inspection during the operation.

Alternate Standard Requirement #5: A new suspended load operation not covered by this SLOAA, deemed necessary due to unusual or unforeseen circumstances where real time action is required, shall be documented and approved by the Center NASA Safety Assurance Director.

Alternate Standard Requirement #6: Suspended load operations associated with operating each payload bay door involve the Zero G system which includes two hoists, one connected to the forward strongback and one connected to the

aft strongback. The hoists are designed, tested, inspected, maintained, and operated in accordance with the NASA Safety Standard for Lifting Devices and Equipment, NSS/GO-1740.9.

During payload bay door operations, each hoist lifts approximately 1740 pounds. Each hoist is rated by the manufacturer at 3200 pounds with a 4 to 1 safety factor. The hoists are load tested annually at 100% and 200% of the working load (1740 pounds).

Each hoist is driven by a worm gear with a 62:1 reduction ratio. The gear operates in an oil bath and directly drives the drum shaft and drum. Each hoist is equipped with a disc brake capable of holding the manufacturer's rated capacity of 3200 pounds.

Alternate Standard Requirement #7: A System Assurance Analysis has been completed on the Zero G system. The SAA includes a Failure Modes and Effects Analysis/Critical Items List (FMEA/CIL) and a Hazard Analysis (see Supporting Documents). The SAA identifies no single failure points. Since the payload bay door is supported by two hoists and the door is stiffened by use of the strongbacks, failure of either hoist will not cause the load to drop.

Alternate Standard Requirement #8: Visual inspection (for cracks or other signs of damage or anomalies) of the lifting equipment and hoist functional checks are performed before each use in accordance with the NSS/GO-1740.9.

Alternate Standard Requirement #9: Trained and licensed hoist operators shall remain at the hoist controls while personnel are under the load.

Alternate Standard Requirement #10: Appropriate control areas are established and maintained prior to and during the operation. Only required personnel (man loaded in the procedure) are permitted in this area.

Alternate Standard Requirement #11: A pretask briefing and a safety walkdown of the area are conducted prior to the lift to ensure that all systems and personnel are ready to support. All participants are instructed on their specific tasks and warned of any hazards involved. Following any crew change, the new personnel are instructed by the task leader on their specific tasks and warned of any hazards involved.

Alternate Standard Requirement #12: Personnel beneath the suspended load will be in radio, visual, or voice contact with the hoist operator/ task leader.

NASA SUSPENDED LOAD OPERATION
ANALYSIS/APPROVAL (SLOAA)

SLO-KSC-1991-034
CHANGE 1, FEBRUARY 1999
PAGE 4 OF 4

Upon loss of communication, the operation shall stop immediately, personnel shall clear the hazardous area, and the load shall be safed. Operations shall not continue until communications are restored.

Alternate Standard Requirement #13: Personnel working beneath the load shall remain in continuous sight of the hoist operator and/or task leader.

Alternate Standard Requirement #14: The Center NASA Safety Assurance Directorate shall conduct periodic reviews to ensure the continued safety of suspended load procedures.

Alternate Standard Requirement #15: The Center NASA Safety Assurance Directorate will provide copies of approved SLOAAs, a list of approved suspended load operations, a list of cranes/hoists used for suspended load operations and copies of the associated FMEA/CIL and hazards analyses to NASA Headquarters.

APPROVAL: DATE: 2/26/99


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